



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/695,336	10/28/2003	Peter J. Geiss	BUR920010184US2	4852
30449	7590	05/11/2006	EXAMINER	
SCHMEISER, OLSEN & WATTS 22 CENTURY HILL DRIVE SUITE 302 LATHAM, NY 12110			DOTY, HEATHER ANNE	
			ART UNIT	PAPER NUMBER
			2813	

DATE MAILED: 05/11/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/695,336

Applicant(s)

GEISS ET AL.

Examiner

Heather A. Doty

Art Unit

2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 31 January 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 23-25, 27-32 and 35-49 is/are pending in the application.
- 4a) Of the above claim(s) 27-32 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 23-25 and 35-49 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 28 October 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Objections

Claim 49 is objected to because of the following informalities: Claim 49 recites the limitation "said polysilicon grain size modulating species" in line 4. There is insufficient antecedent basis for this limitation in the claim. Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless – (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 23-25 and 48 are rejected under 35 U.S.C. 102(b) as being anticipated by Jerome et al. (U.S. 5,565,370).

Regarding claim 25, Jerome et al. teaches a collector (78 in Fig. 6); a base (50 in Fig. 6); and a polysilicon emitter containing a dopant species and a polysilicon grain-modulating species, wherein said dopant species is arsenic and wherein said polysilicon grain-modulating species is antimony (polysilicon layer 100 is implanted with at least one of arsenic and antimony—column 6, lines 16-20—which includes the combination of arsenic and antimony. Jerome et al. does not expressly teach that antimony is present as a polysilicon grain size modulating species, but since it is present in the polysilicon emitter layer, it is inherently the case that it modifies the grain size of the polysilicon, since the instant specification teaches that antimony increases the grain size of polysilicon, after annealing—page 7, line 17 – page 8, line 1).

Regarding claims 23 and 24, Jerome et al. teaches the bipolar transistor of claim 25, and further teaches that the base current of said bipolar transistor is higher than the base current of an identical bipolar transistor fabricated without said polysilicon grain size modulating species and the resistance of said emitter of said bipolar transistor is lower than the emitter of an identical bipolar transistor fabricated without said polysilicon grain size modulating species (Jerome et al. does not expressly teach these properties, but it is inherently the case, as disclosed by Applicant in the instant specification on page 21, lines 10-12—the presence of antimony in the polysilicon emitter increases base current—and on page 22, lines 12-16—the presence of antimony in the polysilicon emitter decreases emitter resistance).

Regarding claim 48, Jerome et al. teaches the bipolar transistor of claim 25. It is further inherently the case that a concentration of dopant is higher at a predetermined distance from a bottom surface of said polysilicon emitter than a concentration of dopant at the same pre-determined distance from a bottom of an identical polysilicon emitter of an identical bipolar transistor without said polysilicon grain size modulating species (the instant specification discloses that the addition of the grain size modulating species antimony causes a concentration of dopant to be higher at a predetermined distance from a bottom surface of the polysilicon emitter than a concentration of dopant at the same predetermined distance from a bottom of an identical polysilicon emitter of an identical bipolar transistor without antimony—page 20, lines 10-17; Fig 13. Although the data shown in Fig. 13 were collected on the device taught by Applicant, Applicant does not disclose the criticality of any difference in structure of their claimed transistor versus

the one taught by Jerome et al. Applicant teaches that the presence of antimony in the polysilicon emitter layer causes this claimed dopant concentration profile, and since Jerome et al. teaches a similar bipolar transistor to the one taught by Applicant, containing a polysilicon emitter layer doped with arsenic and antimony, it is inherently the case that the dopant concentration profile for the device taught by Jerome et al. would mimic that taught by Applicant).

Claims 23-25, 40-45, and 47-49 are rejected under 35 U.S.C. 102(b) as being anticipated by Ueno et al. (U.S. 4,875,085).

Regarding claim 25, Ueno et al. teaches a collector (12 in Fig. 9); a base (13 in Fig. 9) and a polysilicon emitter containing a dopant species and a polysilicon grain-modulating species, wherein said dopant species is arsenic and wherein said polysilicon grain-modulating species is antimony (polysilicon emitter layer 15 is implanted with at least one of arsenic and antimony—Ueno et al., claim 1—which includes the combination of arsenic and antimony. Ueno et al. does not expressly teach that antimony is present as a polysilicon grain size modulating species, but since it is present in the polysilicon emitter layer, it is inherently the case that it modifies the grain size of the polysilicon, since the instant specification teaches that antimony increases the grain size of polysilicon, after annealing—page 7, line 17 – page 8, line 1).

Regarding claims 23 and 24, Ueno et al. teaches the bipolar transistor of claim 25, and further teaches that the base current of said bipolar transistor is higher than the base current of an identical bipolar transistor fabricated without said polysilicon grain size modulating species and the resistance of said emitter of said bipolar transistor is

lower than the emitter of an identical bipolar transistor fabricated without said polysilicon grain size modulating species (Ueno et al. does not expressly teach these properties, but it is inherently the case, as disclosed by Applicant in the instant specification on page 21, lines 10-12—the presence of antimony in the polysilicon emitter increases base current—and on page 22, lines 12-16—the presence of antimony in the polysilicon emitter decreases emitter resistance).

Regarding claim 47, Ueno et al. teaches the bipolar transistor of claim 25, and further teaches that the dopant species, arsenic, is implanted into said polysilicon emitter at a dose of $1\text{E}15$ to $2.3\text{E}16$ atoms/cm² and at an energy of about 40 to 70 keV (column 3, line 64 – column 4, line 1) and the polysilicon grain modulating species antimony is implanted into said polysilicon emitter layer at a dose of $1\text{E}15$ to $1.5\text{E}16$ atoms/cm² and at an energy of 30 to 70 keV (claim 1 teaches implanting one or both of arsenic and antimony; column 4, lines 1-5 teach antimony as a substitution for arsenic, so in the case that arsenic and antimony are both implanted, it is in the energy and dose ranges given for the arsenic implant, which overlaps with the claimed ranges for the antimony energy and dose in claim 45).

Regarding claim 48, Ueno et al. teaches the bipolar transistor of claim 25. It is further inherently the case that a concentration of dopant is higher at a predetermined distance from a bottom surface of said polysilicon emitter than a concentration of dopant at the same pre-determined distance from a bottom of an identical polysilicon emitter of an identical bipolar transistor without said polysilicon grain size modulating species (the instant specification discloses that the addition of the grain size modulating species

antimony causes a concentration of dopant to be higher at a predetermined distance from a bottom surface of the polysilicon emitter than a concentration of dopant at the same predetermined distance from a bottom of an identical polysilicon emitter of an identical bipolar transistor without antimony—page 20, lines 10-17; Fig 13. Although the data shown in Fig. 13 were collected on the device taught by Applicant, Applicant does not disclose the criticality of any difference in structure of their claimed transistor versus the one taught by Ueno et al. Applicant teaches that the presence of antimony in the polysilicon emitter layer causes this claimed dopant concentration profile, and since Ueno et al. teaches a similar bipolar transistor to the one taught by Applicant, containing a polysilicon emitter layer doped with arsenic and antimony, it is inherently the case that the dopant concentration profile for the device taught by Jerome et al. would mimic that taught by Applicant).

Regarding claims 40 and 41, Ueno et al. teaches a single-crystal silicon collector region (12 in Fig. 9; column 3, lines 47-52); a single-crystal silicon base region in said collector region (13 in Fig. 9); a single-crystal silicon emitter layer in direct contact with a top surface of said emitter region, said emitter layer containing a dopant species (arsenic) and an antimony species (layer 15 in Fig. 9; claim 1).

Regarding claims 42 and 43, Ueno et al. teaches the bipolar transistor of claim 40. It is further inherent that the base current of said bipolar transistor is higher than the base current of an identical bipolar transistor fabricated without said antimony species, and the resistance of said emitter of said bipolar transistor is lower than the emitter resistance of an identical bipolar transistor fabricated without said antimony species

Art Unit: 2813

(Ueno et al. does not expressly teach these properties, but it is inherently the case, as disclosed by Applicant in the instant specification on page 21, lines 10-12—the presence of antimony in the polysilicon emitter increases base current—and on page 22, lines 12-16—the presence of antimony in the polysilicon emitter decreases emitter resistance).

Regarding claim 44, Ueno et al. teaches the bipolar transistor of claim 40. It is further inherent that a silicon grain size of said polysilicon emitter layer of said bipolar transistor is greater than a silicon grain size of a polysilicon emitter layer in an identical bipolar transistor fabricated without said antimony species (the instant specification teaches that antimony increases the grain size of polysilicon, after annealing—page 7, line 17 – page 8, line 1).

Regarding claim 45, Ueno et al. teaches the bipolar transistor of claim 40, and further teaches that the dopant species, arsenic, is implanted into said polysilicon emitter at a dose of $1\text{E}15$ to $2.3\text{E}16$ atoms/cm² and at an energy of about 40 to 70 keV (column 3, line 64 – column 4, line 1) and the antimony species is implanted into said polysilicon emitter layer at a dose of $1\text{E}15$ to $1.5\text{E}16$ atoms/cm² and at an energy of 30 to 70 keV (claim 1 teaches implanting one or both of arsenic and antimony; column 4, lines 1-5 teach antimony as a substitution for arsenic, so in the case that arsenic and antimony are both implanted, it is in the energy and dose ranges given for the arsenic implant, which overlaps with the claimed ranges for the antimony energy and dose in claim 45).

Regarding claim 49, Ueno et al. teaches the bipolar transistor of claim 40. It is further inherently the case that a concentration of dopant is higher at a predetermined distance from a bottom surface of said emitter layer than a concentration of dopant at the same pre-determined distance from a bottom of an identical emitter layer of an identical bipolar transistor without said antimony (the instant specification discloses that the addition of antimony causes a concentration of dopant to be higher at a predetermined distance from a bottom surface of the polysilicon emitter than a concentration of dopant at the same predetermined distance from a bottom of an identical polysilicon emitter of an identical bipolar transistor without antimony—page 20, lines 10-17; Fig 13. Although the data shown in Fig. 13 were collected on the device taught by Applicant, Applicant does not disclose the criticality of any difference in structure of their claimed transistor versus the one taught by Ueno et al. Applicant teaches that the presence of antimony in the polysilicon emitter layer causes this claimed dopant concentration profile, and since Ueno et al. teaches a similar bipolar transistor to the one taught by Applicant, containing a polysilicon emitter layer doped with arsenic and antimony, it is inherently the case that the dopant concentration profile for the device taught by Ueno et al. would mimic that taught by Applicant).

Claims 35-37 are rejected under 35 U.S.C. 102(b) as being anticipated by Niitsu (U.S. 5,137,839), with Takemura (U.S. 5,587,326) used to establish inherency for claim 36.

Regarding claim 35, Niitsu teaches a bipolar transistor, comprising:

- a single-crystal silicon collector region (3 in Fig. 8);

Art Unit: 2813

- a single-crystal silicon base region in said collector region (7 in Fig. 8);
- a single-crystal silicon emitter region formed in said base region (11 in Fig. 8); and
- a polycrystalline silicon emitter layer in direct contact with a top surface of said emitter region (11 in Fig. 8), said emitter layer containing a dopant species (arsenic or phosphorus—column 3, lines 7-12) and a carbon species (column 3, lines 19-23), wherein the base current of said bipolar transistor is lower than the base current of an identical bipolar transistor fabricated without said carbon species (Niitsu teaches the bipolar transistor with features as claimed in claim 1, including carbon doping, so it is inherent that the transistor taught by Niitsu would have a base current lower than that of an identical bipolar transistor without the carbon doping, although Niitsu does not expressly teach this).

Regarding claim 36, Niitsu teaches the bipolar transistor of claim 33, wherein the resistance of said emitter of said bipolar transistor is inherently higher than the emitter resistance of an identical bipolar transistor fabricated without the carbon species (Takemura discloses that polysilicon containing carbon has a higher resistance than carbon-free polysilicon, column 5, lines 18-22).

Regarding claim 37, Niitsu teaches the bipolar transistor of claim 33, wherein a silicon grain size of said polysilicon emitter layer of said bipolar transistor is less than a silicon grain size of a polysilicon emitter layer of an identical bipolar transistor fabricated without said carbon species (Applicant discloses in the instant specification that carbon

Art Unit: 2813

doping polysilicon results in a silicon grain size that is less than a silicon grain size of polysilicon not doped with carbon, see pg. 7, line 17 - pg. 8, line 5).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 38 is rejected under 35 U.S.C. 103(a) as being unpatentable over Niitsu (U.S. 5,137,839) in view of Candeleria (U.S. 5,360,986) and Grider et al. (U.S. 6,030,874).

Regarding claim 38, Niitsu teaches the bipolar transistor of claim 35 (note 35 U.S.C. 102(b) rejection above), but is silent regarding the implant dose and energy of the arsenic and carbon ion implantations.

However, Candeleria teaches implanting arsenic into polysilicon at a dose of $1E15$ to $2.3E16$ atm/cm² and at an energy of 40 to 70 KeV (column 3, lines 59-61), and Grider et al. teaches implanting carbon into polysilicon at a dose of $1E14$ to $1E16$ atm/cm² and at an energy of 15 to 35 KeV (column 4, lines 15-17).

Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to fabricate a bipolar transistor according to the method taught by Niitsu, and look to the teachings of Candeleria and Grider et al. for known ion implantation dose and energy values for implanting arsenic and carbon into polysilicon.

Art Unit: 2813

The motivation for doing so at the time of the invention would have been to save time and resources by using values already known in the art of semiconductor devices and ion implantation of arsenic and carbon into polysilicon.

Claim 39 is rejected under 35 U.S.C. 103(a) as being unpatentable over Niitsu (U.S. 5,137,839) in view of Morishita (U.S. 5,708,281).

Regarding claim 39, Niitsu teaches the bipolar transistor of claim 35 (note 35 U.S.C. 102(b) rejection above), but does not teach that the base region includes germanium.

Morishita teaches a bipolar transistor with a base region that includes germanium to narrow the band gap (column 11, lines 11-20).

Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to combine the teachings of Niitsu and Morishita by fabricating a bipolar transistor according to the method taught by Niitsu, and further add germanium to the base region, as taught by Morishita. The motivation for doing so at the time of the invention would have been to narrow the band gap, as expressly taught by Morishita.

Claim 46 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ueno et al. (U.S. 4,875,085) in view of Morishita (U.S. 5,708,281).

Regarding claim 46, Ueno et al. teaches the bipolar transistor of claim 40 (note 35 U.S.C. 102(b) rejection above), but does not teach that the base region includes germanium.

Morishita teaches a bipolar transistor with a base region that includes germanium to narrow the band gap (column 11, lines 11-20).

Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to combine the teachings of Ueno et al. and Morishita by fabricating a bipolar transistor according to the method taught by Ueno et al., and further add germanium to the base region, as taught by Morishita. The motivation for doing so at the time of the invention would have been to narrow the band gap, as expressly taught by Morishita.

Claim 47 is rejected under 35 U.S.C. 103(a) as being unpatentable over Jerome et al. (U.S. 5,565,370).

Regarding claim 47, Jerome et al. teaches the bipolar transistor of claim 25, but is silent regarding the dose and implant energies of the arsenic and antimony implants.

However, it has been held that "where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." *In re Aller* 105 USPQ233, 255 (CCPA 1955)."

Therefore, at the time of the invention, it would have been obvious to one of ordinary skill in the art to make the bipolar transistor taught by Jerome et al., and further optimize the arsenic and antimony implant dose and energies to arrive at the values of a dose of $1E15$ to $2.3 E16$ atom/cm² and at an energy of about 40 to 70 keV for the arsenic implant, and a dose of $1E15$ to $1.5E16$ atom/cm² and at an energy of 30 to 70 keV for the antimony implant.

Response to Arguments

Applicant's arguments with respect to claims 23-25 and 35-46 have been considered but are moot in view of the new ground(s) of rejection.


Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Heather A. Doty, whose telephone number is 571-272-8429. The examiner can normally be reached on M-F, 8:30 - 5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at 571-272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

had


CARL WHITEHEAD, JR.
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800